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AQUATIC INVERTEBRATES OF THE RIBNICA AND LEPENICA RIVERS: COMPOSITION OF THE COMMUNITY AND WATER QUALITY

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Abstract - Results of investigating the community of aquatic invertebrates in the Ribnica and Lepenica Rivers (Kolubara River drainage area) are given in the present work. Forty-three taxa are recorded. In relation to other studied streams in Serbia, the investigated rivers are characterized by high diversity of macroinvertebrates. Cluster analysis indicates that the locality on the Lepenica stands apart from those on the Ribnica, which is a consequence of the difference of habitats found at them. Results of saprobiological analysis of the macrozoobenthos in the given rivers indicate that their waters belong to quality classes I and II.

Key words: Aquatic macroinvertebrates, community composition, Ribnica River, Lepenica River, Kolubara River, Serbia

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INTRODUCTION

In the present work, we set out to elucidate composition of the community of aquatic invertebrates at investigated localities on the Ribnica and Lepenica Rivers. Characteristics of the community are noted, together with field data used to estimate the quality status of the habitat/water.

The investigated drainage area of the Kolubara River lies between the mountains Povlen, Maljen, and Suvobor in the south; Rudnik in the southeast; Kosmaj and Bukulja in the east; and Vlašić, Cer, and Medvednik in the west. The northern border of the Kolubara drainage area represents the line of delimitation between the sub-basins of first-order tributaries of the Sava River and tributaries of the Kolubara River. The watershed has an area of 4500 km² and is rectangular in form. As one of the largest right-hand tributaries of the Sava, the Kolubara River is formed near Valjevo by the confluence of the rivulets Obnica and Jablanica at an elevation of 190 m above sea level (M i l j a n o v i ć, 2001). The Kolubara empties into the Sava (the latter into the Danube at Belgrade) and belongs to the watershed of the Black Sea.

The Ribnica is a right-hand tributary of the Kolubara. It is formed in Breždje (Kozomor) by the Paklešnica and Manastirica Brooks. Its watershed measures 259.6

km² in area, and the river's course has a length of 21.3 km. The stream cuts a deep gorge in its upper course.

The Lepenica is also a right-hand tributary of the Kolubara. Its main source lies on the eastern slopes of Mt. Čuburica, where it arises from the springs Mratišićko Vrelo and Prijezdičko Vrelo. The watershed measures 148.75 km² in area, and the river's course is 28.38 km long.

MATERIAL AND METHODS

Sampling was conducted at four localities, three on the Ribnica and one on the Lepenica. The samples were taken in November of 2004. The sampling sites are presented in Fig. 1.

1. Locality No. 1 - Source region of the Ribnica, village of Breždje, elevation of 340 m above sea level. The river here is 5 m wide and from 0.3 to 0.4 m deep. Habitats consisting of rapids are recorded on the investigated sector. The given locality is situated at 44° 10.258' N latitude and 20° 03.950' E longitude.

2. Locality No. 2 - Ribnica, near the Ranivojević Dam, elevation of 234 m above sea level. Average depth of the river here is 0.4 m. Habitats consisting of rapids are

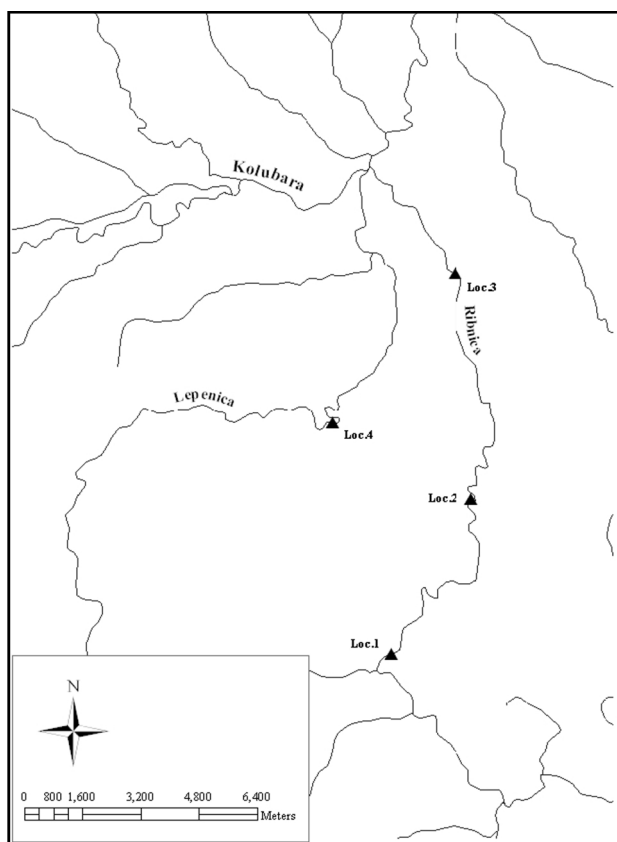


Fig. 1. Sampling sites: 1, 2, 3 – Ribnica River, 4 – Lepenica River.

present on the investigated sector. The substrate is predominantly composed of bedrock and stones (large and small), the rest being made up of gravel and detritus. The locality is situated at $44^{\circ} 13.571' N$ latitude and $20^{\circ} 06.305' E$ longitude.

3. Locality No. 3 - Ribnica, hamlet of Ćosići, 3-4 km from the river's mouth, elevation of 170 m above sea level. Habitats consisting of rapids are recorded on the investigated sector. The substrate is predominantly composed of bedrock and stones (large and small). A small amount of sediment is also present (along the banks). The locality is situated at $44^{\circ} 15.315' N$ latitude and $20^{\circ} 05.554' E$ longitude.

4. Locality No. 4 - Lepenica, village of Sanković near the swimming pool, elevation of 184 m above sea level. The river here is from 2 to 6 m wide and from 0.20 to 1.20 m deep. Rapids and slowly flowing deeper parts are present on the investigated sector. The substrate is composed of large and small stones and gravel, the rest consisting of sediment. The locality is situated at 44°

$15.321' N$ latitude and $20^{\circ} 04.305' E$ longitude.

Morphometric characteristics of the investigated ecosystems (depth and width of the riverbed) were measured at each locality. The following abiotic parameters were measured: water temperature (measured with the aid of a digital thermometer); and pH of the water (measured with a digital pH-meter).

An FBA-semiquantitative net with pore diameter of 500 μm was used to collect bottom fauna samples. The shortest encompassed sector in sampling was 50 m long.

Samples were taken from all accessible habitats (multihabitat sampling procedure). The collected material was immediately transferred to plastic bags and fixed with 4% formalin. Laboratory processing of the material involved separation of organisms from the substrate and their isolation according to groups. Bottom fauna organisms were identified using appropriate manuals for identification (Zhadin, 1952; Bertrad, 1954; Lozek, 1956; Macan, 1970; Mann, 1964; Lepeneva, 1964, 1966; Brinkhurst and Jamieson, 1971; Brinkhurst, 1971; Quigley, 1977; Belifiore, 1983; Kerovec, 1986).

Methods of the structural-analytical approach were used to analyze qualitative and quantitative composition of the biocenosis. The Shannon-Weaver diversity index (Shannon and Weaver, 1949) was used here. Values of the index for an actual community most often vary between 1.0 and 6.0. The diversity maximum of a sample is achieved when all species are equally abundant, where $H_{max} = \ln S$.

Estimation of saprobity was performed by saprobiological analysis of the benthofauna based on the Pantle-Buck method (Pantle and Buck, 1955). The saprobity index S was calculated in the process.

Cluster analysis (CLA) was used in analyzing the results. The Euclidean distance was used as the measure of difference or distance between groups.

RESULTS

Altogether, 43 taxa from 11 groups of macrozoobenthos were recorded at the investigated localities (Table 1).

Of insect orders, the most diverse was Ephemero-

Table 1. List of macrozoobenthic taxa

OLIGOCHETA
GASTROPODA
<i>Bithinia tentaculata</i> (Linnaeus, 1758)
<i>Physa</i> sp.
<i>Theodoxus danubialis</i> (C. Pfeiffer, 1828)
<i>Ancylus fluviatilis</i> (Mueller, 1774)
<i>Fagotia acicularis</i> (Ferussac, 1823)
AMPHIPODA
TRICHOPTERA
<i>Hydropsyche instabilis</i> (Cutris, 1834)
<i>Ryacophila dorsalis</i> (Curtis, 1834)
<i>Hydroptila</i> sp.
<i>Limnephilus</i> sp.
<i>Gaera</i> sp.
<i>Polycentropus flavomaculatus</i> (Pictet, 1834)
EPHEMEROPTERA
<i>Ephemera vulgata</i> (Linnaeus, 1758)
<i>Paraleptophlebia submarginata</i> (Stephens, 1835)
<i>Baetis rhodani</i> (Pictet, 1843)
<i>Baetis alpinus</i> (Pictet, 1843)
<i>Baetis</i> sp. (juv. I frag)
<i>Ecdyonurus venosus</i> (Fabricius, 1775)
<i>Caenis horaria</i> (Linnaeus, 1758)
<i>Heptagenia</i> sp.
<i>Heptagenia sulphurea</i> (Müller, 1776)
<i>Heptagenia flavipes</i> (Charpentier, 1825)
<i>Ephemerella maculocaudata</i> (Ikonomov, 1961)
ODONATA
<i>Gomphus vulgatissimus</i> (Linnaeus, 1758)
<i>Calopteryx virgo</i> (Linnaeus, 1758)
<i>Calopteryx</i> sp.
DIPTERA
<i>Antocha</i> sp.
<i>Ibis marginata</i> (Fabricius, 1781)
<i>Tipula</i> sp.
Tipulidae

tera, with a total of 11 species, followed by Trichoptera (seven species), Diptera without Chironomidae (six species), Coleoptera (five species), and Plecoptera (four species). Among mollusks, five species of Gastropoda were recorded. Less significant in the sense of diversity were Odonata, Heteroptera, Amphipoda, and Oligochaeta. We note that insects as a group occupy a significant place in total diversity of the investigated region.

At locality 1, Ephemeroptera were dominant (57.24%), followed by Trichoptera (23.03%), Chironomidae (5.26%), Coleoptera (4.61%), and Plecoptera (3.95%). In terms of percentage, the participation of Diptera without Chironomidae in the community of macrozoobenthos was 3.27%, while that of Oligochaeta was 1.32%. Other groups were represented to a lesser extent.

At locality 2, Diptera without Chironomidae were best represented (39.73%), followed by Ephemeroptera (24.66%), Chironomidae (21.33%), Trichoptera (8.9%), and Odonata and Plecoptera (2.05% each). The representation of other groups of macrozoobenthos was less than 1%.

At locality 3, Trichoptera were dominant (85%), while the abundance of Ephemeroptera (4.44%) was significantly lower than at the other localities. Odonata were represented with 5% in the total community, Gastropoda with 1.67%, and Plecoptera and Oligochaeta with 1.11% each. The participation of other groups of macrozoobenthos was less significant.

At locality 4, Amphipoda were dominant (63.83%), followed by Gastropoda (17.63%), Odonata (4.56%), and Oligochaeta (4.26%). Diptera and Coleoptera were represented with 3.04% in the total community of aquatic invertebrates.

Insects (especially Trichoptera) were dominant in the total community of the Ribnica River, with average representation of 38.98% at the localities on it.

Locality 4 is situated on the Lepenica River, where Amphipoda were dominant (63.83%) with respect to abundance.

The number of recorded taxa by locality ranged from 19 at localities 2 and 3 to 23 at locality 1. Equality of the number of taxa from one sample to another was recorded at the investigated localities.

Of the total of 23 taxa recorded at locality 1, the largest number belonged to the order Ephemeroptera (seven species), followed by Trichoptera (five species), Diptera (four species), Coleoptera and Plecoptera (two species each), and Odonata (only one species). Among them, the best represented were *Ephemerella maculocaudata* (30.92%), followed by *Hydropsyche instabilis* (11.84%), *Ecdyonurus venosus* (8.55%), and *Paralepto-*

phlebia submarginata (7.89%).

At locality 2, 19 taxa were recorded, seven of which belonged to the group Ephemeroptera, four to each of the groups Diptera and Trichoptera, and one taxon to each of the groups Odonata, Coleoptera, Plecoptera, and Gastropoda. The best represented taxa at this locality were *Antocha* sp. with 37.67% and Chironomidae with 21.23%.

At locality 3, five out of a total of 19 recorded taxa belonged to the order Trichoptera and an equal number to the order Ephemeroptera. Two taxa belonged to each of the groups Odonata, Diptera, and Gastropoda, while Plecoptera were the least represented, with only one taxon. With 78.33% of the community of macrozoobenthos, *Hydropsyche instabilis* was clearly dominant at this locality.

Out of a total of 22 taxa recorded at locality 4, the greatest number (five taxa) belonged to Trichoptera, followed by Coleoptera and Gastropoda (four taxa each), Diptera (three taxa), Odonata (two taxa), and Ephemeroptera, Heteroptera, Amphipoda, and Oligochaeta (one taxon each). Among them, Amphipoda were best represented, with 63.83%, while *Bithynia tentaculata* was represented with 12.46%.

The Shannon-Weaver diversity index (Shannon and Weaver, 1949) ranged from 1.28 to 1.36 at the investigated localities.

Localities were grouped by applying cluster analysis to the community of macroinvertebrates (Fig. 2). The presented results indicate that the locality on the Lepenica River stands apart from those on the Ribnica.

DISCUSSION

Altogether, 43 taxa from 11 groups were recorded in investigation of the community of macrozoobenthos in the Ribnica and Lepenica Rivers. In view of the fact that identification of individual organisms (Chironomidae, Oligochaeta, Amphipoda) has to date been performed only to the level of higher taxonomic categories, it can be asserted that the faunistic list of macrozoobenthic forms is not final and that diversity presumably is even greater.

Taking into account the fact that our investigation encompassed only the autumn aspect of their ecosystems, we can safely say that the investigated rivers in relation

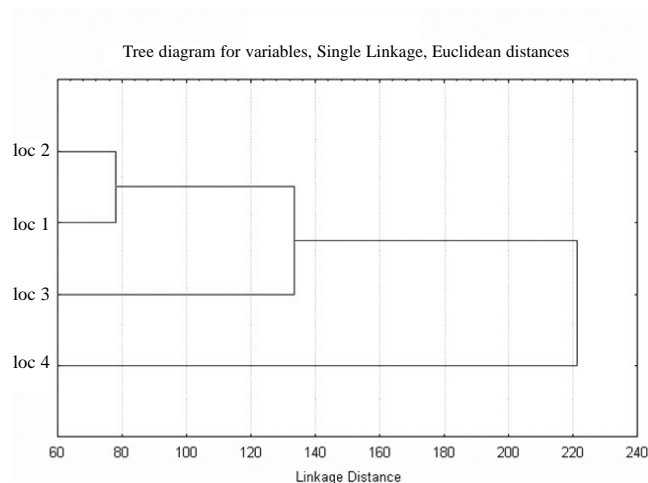


Fig. 2. Results of cluster analysis. Relative abundance of the fauna at the investigated localities constituted the input data.

to other studied streams in Serbia (Filipović, 1954, 1957, 1967, 1969, 1975, 1976; Kaćanski, 1980; Jakovčev, 1983; Jakovčev *et al.*, 1995; Simić, 1995; Marković *et al.*, 1997; Konta, 1997) are characterized by high diversity of the fauna of aquatic invertebrates.

Our investigations indicate that the insect groups Ephemeroptera and Trichoptera are characterized by the greatest diversity. They are followed by Diptera with Chironomidae, Coleoptera, and Plecoptera. Odonata, Heteroptera, Amphipoda, and Oligochaeta can be singled out as groups less significant in regard to diversity.

The number of recorded taxa by locality ranged from 19 at localities 2 and 3 to 23 at locality 1. Equality of the number of taxa from one sample to another was recorded at the investigated localities.

In contrast to the first three localities (where insect species were dominant), locality 4 was characterized by dominance of Amphipoda, with 63.83% of the total of 22 species. Apart from Amphipoda, *Bithynia tentaculata* also represents a significant share of the community, with 12.46%. Classification of localities by cluster analysis best illustrates the spatial dynamics of their macrozoobenthos (Fig. 1). Such analysis indicates that the locality on the Lepenica River stands clearly apart from those on the Ribnica.

The differences in the fauna recorded at the locality on the Lepenica in relation to those on the Ribnica that are responsible for isolation of the former in cluster analysis result from the presence of different habitats. In ad-

dition to rapids (characteristic of the investigated sectors of the Ribnica), the Lepenica also has more slowly flowing deeper parts. The conditions in habitats with slower current are different from those in habitats with rapids, which makes possible the survival of certain species characteristic of a combination of typical habitats. Of species typical of habitats with slower current, we single out *Gomphus vulgatissimus* (Insecta, Odonata), which occurred with greater population density than at localities 1 and 2; and the snail species *Ancylus fluviatilis*, *Bithynia tentaculata*, and *Fagotia acicularis*, which were more significantly represented at locality 4 than at the other localities. In addition to the mentioned differences, representatives of the order Ephemeroptera were significantly represented at the localities on the Ribnica, whereas only three specimens of the species *Ephemera vulgata* were recorded on the Lepenica.

The recorded community of macroinvertebrates points to good water quality as far as the presence of organic matter is concerned. The results of saprobiological analysis indicate that waters of the Ribnica and Lepenica Rivers belong to quality classes I and II.

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ВОДЕНИ БЕСКИЧМЕЊАЦИ РИБНИЦЕ И ЛЕПЕНИЦЕ – САСТАВ ЗАЈЕДНИЦЕ И КВАЛИТЕТ ВОДЕ

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У раду се приказују резултати истраживања водених бескичмењака река Рибнице и Лепенице (слив реке Колубаре). Забележено је укупно 43 таксона. Истраживане реке одликују се високим биодиверзитетом у поређењу са другим испитиваним текућницама Србије. Према резултатима

cluster анализе, локалитет на Лепеници издваја се у односу на локалитете на Рибници, што је последица разлике у анализираним стаништима. Констатована заједница макрозообентоса указује на добар квалитет воде који је на граници I и II класе бонитета.